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Feature Article - Direct Movement Estimator for the Survey of Average Weekly Earnings

Introduction

Many users of the ABS Survey of Average Weekly Earnings (AWE) (cat. nos. 6301.0 and 6302.0) are interested in the quarterly and annual movements in average weekly ordinary time earnings for full-time adults (AWOTE). Due to the existence of highly overlapping quarterly samples and the strong correlation of data items collected from the same business from one quarter to the next, the quarterly and annual differences of the published level estimates of AWOTE are good measures of quarterly and annual movements. There have, however, been recent suggestions that these estimates of movement in AWOTE could be improved by the use of common sample based estimates.

To investigate this, the ABS has designed an unbiased common sample based estimator referred to as the direct movement estimator. This article discusses the advantages and disadvantages of using this alternative estimator to measure movements in AWOTE for the AWE survey, and then compares the quarterly and annual movement estimates of AWOTE for the published series against those calculated by the direct movement estimator.

The direct movement estimator

The direct movement estimator constructed by the ABS to estimate movements in AWOTE for the AWE survey is a simple version of a more general estimator known in sample survey literature as a composite estimator, where businesses are given different weights depending on their stratum and selection status for the two time periods over which the movement is being measured.

Businesses which are selected in both time periods from the same stratum are referred to as common sample businesses and receive the largest weights. Businesses which enter the population ('births') or leave it ('deaths') and which are selected in the sample in the corresponding time period retain their selection weight, as do businesses which change size or industry stratum and are selected in both time periods. These businesses represent the population changes between the two time periods. Finally, businesses which are in the population and in the same stratum for the two time periods but are only selected for one time period are referred to as rotating businesses. These are given a weight of zero. The original selection weights for the rotating businesses are thus distributed among the common sample businesses. This is equivalent to imputing a movement for rotating businesses which is equal to the average movement for common sample businesses in the same stratum.

The direct movement estimator is representative of the whole population as the expected sum of the weights at each time period is equal to the population total at that time period. It is also an unbiased estimator of the movement in AWOTE.

Advantages of the direct movement estimator

Provided a high proportion of selections are included in the common sample between the two time periods, the direct movement estimator is expected to have a lower standard error for the movement in AWOTE than the estimator currently used. This occurs because the direct movement estimator removes one aspect of sampling error from the estimates, namely, the effect of the rotating businesses. Reported values from rotating businesses do not contribute to the direct movement estimates, since they are represented by the common sample businesses. For common sample businesses there is likely to be high correlation between the reported data items across the two time periods.

By ignoring rotating businesses, the direct movement estimator precludes the effect of, for example, businesses with relatively low average earnings being replaced by businesses with relatively high average earnings purely by chance. This results in a lower standard error of movement. The lower the standard error of an estimate, the greater its reliability and hence usefulness in making statistical inferences.

Disadvantages of the direct movement estimator

The AWE survey generally has high overlap between quarterly samples (around 90%); however the overlap within some individual strata may be considerably lower. If a stratum has no common businesses in the sample (as defined by the direct movement estimator), the direct movement estimate will not be fully representative of the population and will therefore be biased.

Furthermore, if there are very few common businesses between the two time periods for a particular stratum, these businesses will have substantially higher weights, making the estimate of movement less robust. These problems are likely to have a greater effect on annual rather than quarterly common sample direct movement estimates, since the overlap between samples one year apart averages around 67%. However substantial rotation between quarterly samples can occur due to one-off events such as changes in survey selection procedures, major alterations to the sampling population or sample redesigns.

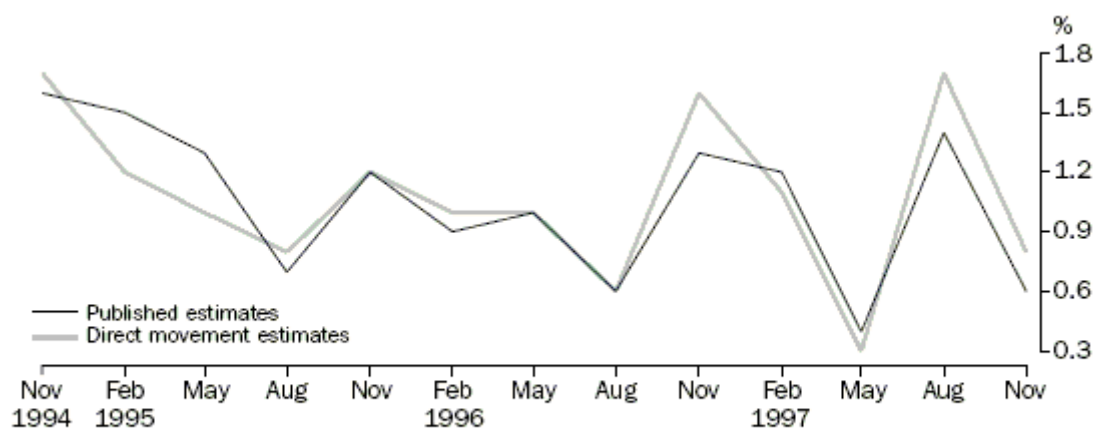
Ideally, the estimate of movement between any two time periods should be equal to the difference in the level estimates for each time period. If a direct movement estimator was used for estimating movements and the current estimator was used for estimating levels, then this consistency would not exist. To address this issue a time series of level estimates could be constructed by adding the direct movement quarterly movement estimate to the previous quarters level estimate, starting from some base quarter. However the resultant quarterly estimates of level would have a higher sampling error than the current level estimates (as they are based on fewer businesses), with sampling error on these level estimates increasing over time. These estimates could stray significantly over time from the best available level estimates of the series at a point in time (which are those currently published using all of the reported data). Additionally, whilst short term movement estimates (e.g. sub annual) derived from a series constructed in this manner are likely to be somewhat more accurate than those based on the current published estimates, this improvement in accuracy will deteriorate for longer term movements.

Comparison of quarterly movement estimates in AWOTE

Graph 1 shows a time series of quarterly movement estimates in AWOTE for the published series and those derived from the direct movement estimator from November 1994 to November 1997. The graph shows that, in general, the estimators behave similarly over time, with the maximum difference between the two sets of estimates for any one quarterly movement being 0.3 percentage points and the average absolute difference over all quarterly movements analysed being 0.15 percentage points. The differences appear to follow a random pattern, with the direct movement estimates being larger than the published estimates for six quarterly

movements, smaller for four quarterly movements and the same for three quarterly movements. The overall average difference between the two estimators is only 0.02% percentage points.

1 QUARTERLY MOVEMENT IN AWOTE ESTIMATES



Source: ABS 6302.0 and unpublished data

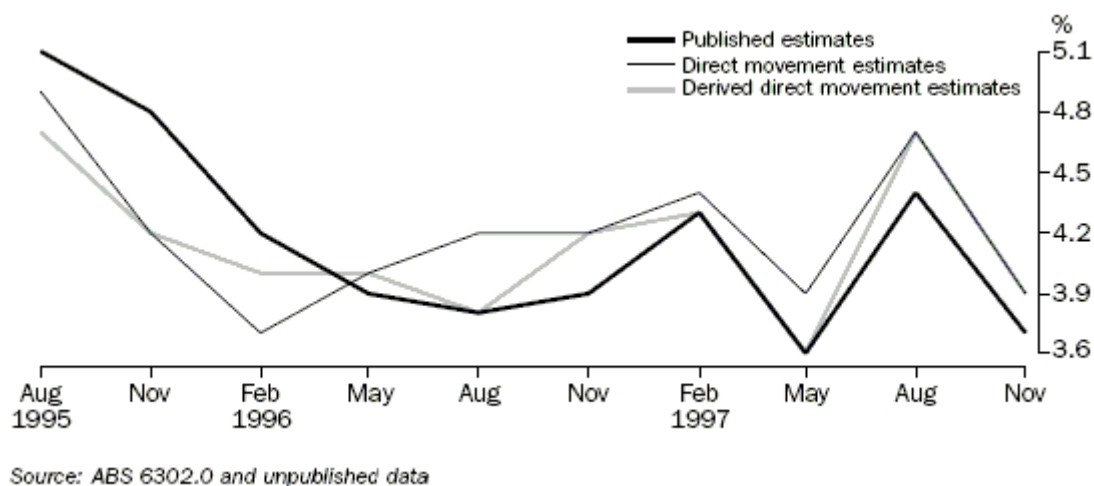
The average common sample overlap between quarterly samples for this period was 89%. Standard errors for the direct movement estimates were lower than those for the published estimates for all quarterly movements in AWOTE analysed; however this improvement in accuracy was 11% on average.

Comparison of annual movement estimates in AWOTE

Graph 2 shows a time series of annual movements in AWOTE from August 1995 to November 1997 for three different estimators: the published series of annual movements; the direct movement estimator based on matching samples one year apart; and the annual movements derived from the sum of the four constituent quarters' direct movement estimates, which is denoted as the derived direct movement estimate of annual movement in AWOTE.

As with the quarterly movement series, the annual movement estimators behave similarly over time. The maximum difference between the published estimates and the two alternative estimators of annual movement in AWOTE is 0.6 percentage points. The average absolute difference is 0.3 percentage points between the published and the direct movement estimator and 0.2 percentage points between the published and the derived direct movement estimator. Over the analysis period, the published series initially has slightly higher estimates of annual movement in AWOTE and then slightly lower estimates for the more recent periods. This is reflected in the overall average difference, which is 0.01 percentage points between the published and the direct movement estimator, and 0.02 percentage points between the published and the derived direct movement estimator.

2 ANNUAL MOVEMENT IN AWOTE ESTIMATES



The average common sample overlap for samples one year apart was only 61% over the analysis period. This is reflected in the standard errors of annual movement for the direct movement estimator, which were 7% greater on average than the standard errors of annual movements for the published series. As mentioned above, the derived direct movement estimator becomes less accurate the longer the interval of movement to be estimated. Estimating the standard error of the derived direct movement estimator of annual movement in AWOTE is a complex task, and is beyond the scope of this study. However, it is clear that any improvement in accuracy would be considerably lower than the 11% average which was observed for quarter to quarter movement.

Conclusion

Obtaining accurate estimates of the movement in AWOTE is a major design objective for the AWE survey. To achieve this the ABS employs a planned sample rotation policy to ensure high overlap in quarterly samples whilst also controlling the reporting load on small businesses.

This article presented the direct movement estimator, an alternative estimator which focuses on the common sample between two quarters and can achieve lower sampling error for quarterly movements in AWOTE than the published series. However, the direct movement estimator will perform poorly and be subject to bias if there is a low common sample between two quarters (which may occur due to one-off effects, such as sample redesigns and major adjustments to the sampling population).

A comparison between the published series and estimates from the direct movement estimator was made for both quarterly and annual movements in AWOTE over the period August 1994 to November 1997, with results showing very little difference between the estimators. Small gains in accuracy could be made by the direct movement estimator for estimating quarterly movements in AWOTE; however, such gains were not evident for annual movements in AWOTE.

The ABS appreciates that its major clients require a reliable measure of wages growth to support informed decision making. The main limitation of the currently published AWOTE movement estimates is their inability to separate pure wages growth from compositional impacts. The direct movement estimator cannot address this issue. The ABS has recently devoted considerable resources to develop a Wage Cost Index that will specifically measure wages growth, and many user needs will be served best by focusing on this new series.

A move to direct movement estimates for the AWE survey in the interim would be costly to implement in operational computing systems, and liable to cause confusion. The benefits would

only apply to short term AWOTE movement estimates and, as seen in this analysis, the improvement in terms of standard errors is relatively small. Given this, and the new focus on the recently developed Wage Cost Index, the ABS does not intend to revise estimation practices for the AWE survey.

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